

## CLAIMS

I claim:

1. A method of shifting the resonance curves of an optical ring filter using the Kerr effect comprising the steps of:

Coupling an incident optical wave (" $W_{inc}$ ") to one of the optical bus waveguides (the "buses") of an optical ring filter comprising two buses coupled to a ring waveguide resonator (the "ring");

Setting the value of the wavelength  $\lambda_{inc}$  of  $W_{inc}$  to one of the resonant wavelength values of the ring resulting in  $W_{inc}$  propagating through the ring to the other bus;

Increasing the optical intensity of  $W_{inc}$ , causing a shift in the refractive index value of the ring due to the Kerr effect, up to a working point where the resonant intensity of  $W_{inc}$  remains large enough to maintain the shift of the value of the refractive index of the ring;

Resulting in a shift of the resonance curves of the ring, which are also the resonance curves of the optical ring filter.

2. A method of achieving All-Optical Wavelength Switching with an optical ring filter using the Kerr effect as claimed in claim 1 and comprising the steps of:

Coupling a new optical wave (" $W_{new}$ ") with continuous optical intensity into the optical ring filter and setting the value of its wavelength  $\lambda_{new}$  to one of the resonant wavelength values of the ring;

Coupling  $W_{new}$  into one of the buses such that  $W_{new}$  and the incident optical wave  $W_{inc}$  are counter-propagating in the ring;

Modulating the optical intensity of  $W_{inc}$  and increasing its average optical intensity so as to induce the Kerr effect and a shift of the resonance curves of the ring;

Varying the shift of the resonance curves by modulating the optical intensity of  $W_{inc}$  according to the modulation pattern of  $W_{inc}$ , thereby causing a change to the resonance of  $W_{new}$  in the ring and, therefore, to the optical intensity of  $W_{new}$  at the output port of the bus where  $W_{new}$  was initially coupled such that the modulation of the intensity of  $W_{new}$  at this port matches the modulation pattern of  $W_{inc}$  resulting in an all-optical transfer of the intensity modulation pattern of  $W_{inc}$  to  $W_{new}$ ;

Selecting  $\lambda_{new}$  different from  $\lambda_{inc}$  thereby achieving all-optical wavelength conversion also known as all-optical wavelength switching.

3. A method of achieving All-Optical Wavelength Tuning with an optical ring filter using the Kerr effect as claimed in claim 1 and comprising the steps of:

Using a broadband source to produce an incident optical wave  $W_{inc}$ , which has a subset of its spectral components matching the band-pass of the ring and therefore being resonant, with the subset being determined by the optical intensity of  $W_{inc}$  due to the Kerr effect;

Coupling  $W_{inc}$  to one of the buses of the ring and coupling the optical wave to be filtered out by the optical ring filter (" $W_{filt}$ ") to one of the buses of the ring such that  $W_{filt}$  and  $W_{inc}$  are counter-propagating in the ring;

Increasing or decreasing the optical intensity of  $W_{inc}$  so as to shift respectively forward or backward the resonance curves of the ring thereby tuning the optical wavelength that  $W_{filt}$  must have to be resonant in the ring and to be filtered out by the optical ring filter from one bus to the other bus.

4. A method of achieving All-Optical Wavelength Dropping with an optical ring filter using the Kerr effect as claimed in claim 3 and comprising the steps of:

Coupling a bundle of optical waves (" $W_{bund}$ ") to one of the buses where  $W_{inc}$  is not initially coupled and in such a way that  $W_{bund}$  and  $W_{inc}$  are counter-propagating in the ring;

Selecting a spectrum of wavelengths of  $W_{bund}$  that is smaller than the free spectral range of the ring;

Tuning the wavelength to be filtered out by the optical ring filter by increasing or decreasing the optical intensity of  $W_{inc}$ ;

Matching the wavelength of  $W_{filt}$  to the optical wavelength of the optical wave in the bundle that is desired to be dropped (" $W_{drop}$ "), thereby causing  $W_{drop}$  to be resonant in the ring and coupled from one bus to the opposite bus through the ring while the remaining waves of  $W_{bund}$  are coupled at the output port of their initial bus resulting in the dropping of the desired optical wave from the bundle of optical waves;

5. A method of achieving All-Optical Wavelength Adding with an optical ring filter using the Kerr effect as claimed in claim 4 and comprising the steps of:

Coupling an optical wave desired to be added (" $W_{add}$ ") to  $W_{bund}$  to the bus where  $W_{inc}$  is initially coupled and in such a way that  $W_{add}$  and  $W_{inc}$  are counter-propagating in the ring;

Selecting the optical wavelength  $\lambda_{add}$  of  $W_{add}$  that is different from each optical wavelength of the optical waves of  $W_{bund}$ ;

Increasing or decreasing the optical intensity of  $W_{inc}$  so as to tune the wavelength filtered out by the optical ring filter to match it to the wavelength  $\lambda_{add}$ , thereby causing  $W_{add}$  to be resonant in the ring and coupled from its initial bus to the bus where  $W_{bund}$  is coupled resulting in the addition of  $W_{add}$  to  $W_{bund}$  at the output port of this bus.

6. A method of achieving All-Optical Add-and-Drop Multiplexing with an optical ring filter using the Kerr effect by combining the methods claimed in claim 4 and claim 5 in the same optical ring;

7. A method of achieving All-Optical Space Switching using All-Optical Add-and-Drop Multiplexers as claimed in claim 6 and comprising the steps of:

Interconnecting several All-Optical Add-and-Drop Multiplexers in a matrix;

Coupling at each input of the  $N$  optical inputs of the matrix a bundle of optical waves;

Adding, dropping or passing each wave of the bundle of optical waves through the add-and-drop multiplexers and coupling said waves to one chosen optical output of the  $M$  optical outputs of the matrix achieving, thereby, All-Optical Space Switching.

8. A method of achieving All-Optical Intensity Modulation with an optical ring filter using the Kerr effect as claimed in claim 3 and comprising the steps of:

Coupling the optical wave to be modulated (" $W_{\text{mod}}$ ") to one of the buses such that  $W_{\text{mod}}$  and  $W_{\text{inc}}$  are counter-propagating in the ring;

Tuning the wavelength to be filtered out by the optical ring filter to a point where it matches the optical wavelength  $\lambda_{\text{mod}}$  of  $W_{\text{mod}}$ ;

Increasing or decreasing the optical intensity of  $W_{\text{inc}}$  around said point so as to tune the resonance curves over the band-pass of the ring resonator, thereby causing  $W_{\text{mod}}$  to be more or less resonant and causing part of its intensity to be coupled at the output port of its initial bus resulting in All-Optical Intensity Modulation.